

# Determinants of Public Debt for middle income and high income group countries using Panel Data regression

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## Abstract:

*To be able to predict when a nation will go bust has been one of toughest challenges in macroeconomics. Considerable research and effort has been put into this direction but still we are not in a position to say anything with certainty. This paper analyzes panel pool data on 31 countries across the world for the past 30 years on the basis of which the possibility of a sovereign default can be explored. The aim of this study is to understand which all factors influence the public debt in middle and high income group countries using Panel regression. Total effects model, Cross section fixed effects model, Cross section random effects model have been used to understand the factors whereas Autoregressive multiple regression model has been used to forecast the debt figures. The research findings suggest that the most important determinant of debt situation is GDP growth rate for both high and middle income group countries. In addition to this, Central government expenditure, education expenditure and Current account balance are also seen to influence the debt situation for both groups. FDI and Inflation have no impact on debt to GDP ratios among high income group countries but are found to be of more relevance when determining debt situation of middle income group countries. Population density and population above 65 years of age do not have any impact whatsoever on debt to GDP ratios of high and middle income group countries. Forecasts for weighted average public debt for high income group countries indicate steady increase. Debt situation of countries including Switzerland, Korea, Slovak rep, France and Japan is likely to worsen over the next 5 years. The debt situation of Greece and Spain is unlikely to change much whereas Ireland, USA, Canada, Italy, Hungary are expected to get better till 2015.*

## 1. Introduction:

Any country on the threshold of development and seeking to shift gears toward economic stability has to precipitate a major surge in the sectors which propel growth, mainly consumption, production and investment. Spending on education, health, sanitation, public goods like roads & highways and social security is in a way government's moral responsibility. Moreover, these are areas in which the investment required is so colossal that it would be unviable for any private investors to consider. But, a spending of this sort by the government boosts business confidence and encourages private investment. The tipping point for this economic galvanization is often a major initial injection of funds by the central government. The nature and quantum of this capital is often not backed by equal flow of revenue stream and calls for borrowing to fill the gap, especially for the emerging and developing nations. This leads to building up of debt and incurring of liabilities on part of the government. The key principle underlying this kind of a credit structure is the fact that the eventual gains accruing from the investment will cover the cost of incurring and carrying the debt. Moreover the developmental and other social incentives pertaining to this kind of a measure are too overwhelming for any government to ignore.

Thus any nation with aspirations of achieving growth and associated developmental incentives has to eventually witness a swelling of its credit figures. Hence, economic prudence would justify the incurring of liabilities with an intention of translating it into beneficial corresponding assets. The debt situation however assumes an unruly character, when owing to a lack of generating substantial revenue inflows; the government finds itself in a spot of bother when it comes to interest and principal repayments.

Rogoff and Reinhart(2008) state that virtually the entire world has at some point of time in history incurred debts and has invariability failed in varying degrees. Even the advanced and modern economies of today have in their initial days resorted to debt.

The Keynesian School of Economics justifies government debt as a repercussion of undertaking spending to boost the economy.

To be able to predict the possibility of a sovereign default, it becomes important to understand debt to GDP ratio, levels it attained for various economies, factors influencing debt to GDP ratio, forecast Debt to GDP ratio for the major economies. This study is also on similar lines

## 2. Literature review:

Rogoff and Reinhart (2008) found that serial default is a nearly universal phenomenon as countries struggle to transform themselves from emerging markets to advanced economies. Major default episodes are typically spaced some years (or decades) apart, creating an illusion that "this time is different" among policymakers and investors.

In an IMF Report (2003), it is argued that there is no defined rule to determine whether a government's debt is sustainable or not. Thus a commonly used approach is to observe public debt to GDP ratio, if the ratio is stable over time then the fiscal policy can be considered as sustainable.

Similarly an IMF Report (2008) finds that the fiscal policy as a countercyclical tool is less effective in countries with high public debt: for industrial countries it is defined as above 75 percent of GDP and for emerging markets as above 25 percent of GDP. Similarly, according to IMF Report (2009) effectiveness of fiscal policy in stimulating aggregate demand during recessions is inversely related to the level of public debt which is in confirmation of the above finding. It found that for debt levels

exceeding around 60 percent of GDP, the point estimate of the impact of government consumption on the strength of economic recovery becomes negative.
Broda & Weinstein (2004) define a fiscal policy as sustainable if the current policy can be continued indefinitely with a stable government debt-to-GDP ratio. If the deficits are too high, the stock of government debt expands until the private sector ceases being willing or able to supply the government with credit, forcing a crisis in the form of monetizing or repudiating the debt. Similarly, if surpluses are too high, the government is forced to purchase private assets and gradually nationalize the economy.
In a research report (World Bank 2005), changes in public debt-to-GDP ratios are broken down into components attributable to primary fiscal deficits, real GDP growth, real interest rates, the capital gain/loss on foreign currency denominated debt as result of exchange rate changes and fiscal costs associated with contingent liabilities such as bank bailouts. The analysis draws upon 31 market access countries (MACs), for 15 of which detailed case studies are done. The major factors taken into consideration in this study are primary deficit as a share of GDP, real GDP growth rate, weighted averages of domestic and foreign interest rates, domestic inflation rate, share of foreign currency denominated debt in total public debt, and RXR is the change in (bilateral, US dollar per local currency unit) real exchange rate.

Regarding panel unit root test framework, two generations of tests have been developed so far: a first generation (Levin, Lin and Chu test (2002), Im, Pesaran and Shin test (2003) and Fisher-type tests) whose main limit is the assumption of cross-sectional independence across units; a second generation of tests that rejects the cross-sectional independence hypothesis.

Blander, Dhaene and Leuven (2007) state that “Most unit root tests for panel data are based on test statistics that have a limiting normal distribution as N:T approaches infinity and T approaches infinity sufficiently fast compared to N. These include the tests suggested by Quah (1994) and Levin (2002). Maddala and Wu (1999) and Choi (2001) proposed using the Fisher (1932) test, which has an asymptotic distribution as T approaches infinity with fixed N. Several of these tests, notably the Levin et al. (2002) and Im et al. (2003) tests, allow for a considerable degree of cross-sectional heterogeneity, such as heterogeneous intercepts, trends and serial correlation. Micro-economic panel data sets often have large N and relatively small T. In these situations, the large N, large T asymptotic distributions of the above tests may be poor approximations to their finite sample distribution. This motivated interest in tests whose large N, fixed T asymptotics can be derived, while still allowing for cross-sectional heterogeneity in the underlying model.”

## 3. The Model

Mathematically national debt is defined as the sum of all previously incurred annual federal deficits and since the deficits are financed by government borrowing, national debt is equal to all government debts which are yet to be paid off. This critical description of national debt essentially breaks down the concept of debt as a composition of the fiscal deficits and the liability incurred to finance it. With a central focus on understanding debt sustainability, debt is created essentially by the onset of fiscal deficits as well the servicing of the measures undertaken to combat the former.

Panagriya (2008) indicates that debt creation takes place when the rate at which deficit grows is not squared off by an equal or greater rate of GDP growth.

Debt in period t= debt in period in period t-1 + D

where D is fiscal deficit in period t Since D = primary deficit + Interest payment

And further interest payment in period t = Interest rate for period t-1 (r) * Debt for period t-1

Hence debt level in period t = debt level in period t-1 + primary deficit + r * debt for t-1

Dividing both sides by GDP of current period:

$$b_t = \frac{\text{debt level in period t}}{\text{GDPt}} + \text{pd} + \text{r}\left(\frac{\text{debt level in period t}-1}{\text{GDPt}}\right)$$

Where $b_t$ = Debt to GDP ratio in period t

pd = primary deficit to GDP ratio

r= interest rates in period t-1 (at which debt is being repaid)

Let g be growth rate of GDP: $GDP_t = GDP_{t-1} * (1+g)$

$$\text{Hence } b_t = \frac{b_{t-1}}{(1+g)} + \text{pd} + \text{r} * \frac{b_{t-1}}{(1+g)}$$

$$b_t = b_{t-1}\frac{(1+r)}{(1+g)} + pd$$

$$pd = b_t - b_{t-1}\frac{(1+r)}{(1+g)}$$

For debt to GDP to remain unchanged, $b_t = b_{t-1}$

Applying this condition:

$$pd = \frac{(b_t * g - b_{t-1} * r)}{(1+g)}$$

$$pd = \frac{(b_{t-1} * g - b_{t-1} * r)}{(1 + g)}$$

$$pd = b_{t-1} \frac{(g - r)}{(1 + g)}$$

**(Equation 1)**

Debt sustainability hence depends upon following factors mathematically:

- Interest rate r (linked with inflation)
- Primary deficit (linked with government expenditure and its types)
- Growth rate g (based on GDP of a country)

The purpose of this research is to validate the above model (equation 1) statistically. In addition to these variables, Inflation and current account are two more variables which do not figure into the mathematical model, but none the less are two most important macroeconomic parameters and have the potential to influence the debt situation and hence have been considered.

## 4. Methodology

A panel data for the period 1993-2008 for high income group countries and 1980-2008 for middle income group countries, on variables mentioned in the table below, is collected. The major sources of data are World Bank database, OECD statsbook, IMF forecasts and CIA world fact book. High income and middle income distinction is consistent with the definition of World Bank. The stationarity of the variables is checked and the panel is made balanced.

In lieu of above consideration, countries like Argentina, South Africa, Russia were dropped from the set of middle income group to make the panel strongly balanced. Variables like health expenditure had to be dropped because of unavailability of data across the entire range.

GDP considered is nominal GDP at current prices in USD and GDP growth rate is yoy rate of real GDP.

Interest rate is long term rate of borrowing prevailing in the country. Interests rates govern the rate at which new debt can be raised and hence the interest expenditure.

The effect of fiscal deficit has been captured by taking into account General government consumption expenditures as percentage of GDP.

The following table summarizes countries taken into consideration, variables included and the time frame.

Table 1 List of Countries and Variables included

| Countries | High income/Middle income | % of World GDP (2009) | Independent Variables included | Time frame under consideration | |
|---|---|---|---|---|---|
| **Australia** | H | 1.968 | Current account balance | | |
| **France** | H | 4.124 | | | |
| **Germany** | H | 5.335 | Government expenditure | | |
| **Italy** | H | 3.286 | | | |
| **Japan** | H | 8.700 | FDI | | |
| **United States** | H | 23.601 | Education Expenditure | | |
| **Canada** | H | 2.523 | | | |
| **Korea, Rep.** | H | 1.591 | GDP | | |
| **Denmark** | H | 0.491 | GDP growth | 1993-2008 | 4000 Data values |
| **Czech Republic** | H | 0.315 | Inflation | | |
| **Greece** | H | 0.492 | Interest rate | | |
| **Hungary** | H | 0.213 | Population density | | |
| **Ireland** | H | 0.329 | Population above 65 | | |
| **Portugal** | H | 0.361 | | | |
| **Poland** | H | 0.708 | Total Debt | | |
| **Spain** | H | 2.218 | External debt | | |
| **Slivak Republic** | H | 0.139 | Military expenditure | | |
| **Sweden** | H | 0.717 | | | |
| **Switzerland** | H | 0.843 | Energy imports as % of energy expenditure | | |
| **China** | M | 9.271 | Current account balance | | |
| **India** | M | 2.307 | | | |
| **Brazil** | M | 3.265 | Government expenditure | | |
| **Indonesia** | M | 1.121 | | | |
| **Mexico** | M | 1.620 | FDI | | |
| **Turkey** | M | 1.176 | GDP | | |
| **Colombia** | M | 0.456 | GDP growth | | 3960 Data values |
| **Chile** | M | 0.321 | Inflation | 1980-2009 | |
| **Philippines** | M | 0.305 | Interest rate | | |
| **Thailand** | M | 0.504 | Population density | | |
| **Peru** | M | 0.247 | Population above 65 | | |
| **Venezuela, RB** | M | 0.460 | | | |
| | | | Total Debt | | |
| | | | External debt | | |
| | | | Education Expenditure | | |
| **Total** | | 79.007 | | | |

In order to understand and appreciate the difference between expenditure patterns of middle income and high income group countries, various types of expenditures like education, military have been taken into account. All these variables are also expressed as percentage of GDP.
Because pensions also form a major chunk of the government expenditures and because of unavailability of data on the pensions, population above 65 years of age and population density have been taken into account as proxy variables.
Apart from these Inflation and current account are two more variables which do not figure into the mathematical model (equation 1), but none the less are two most important macroeconomic parameters and have the potential to influence the debt situation and hence have been considered.
The dependent variable is total debt as percentage of GDP in both middle income and high income countries. The intention is to prepare a multiple regression model to determine the total debt for both the middle income and high income countries. Based on the quality of the model generated, forecasting of debt will be carried out.

Type of stationarity tests to be done depends upon the following factors

1. N/T ratio
2. Type of panel (balanced/unbalanced or partially balanced)
3. Cross sectional heterogeneity assumption`

Three possible stationarity tests which can be carried out and the corresponding requirements are:

**Table 2 Possible Stationarity Tests**

| Type of test | N/T Ratio | Type of Panel | Cross sectional heterogeneity |
|---|---|---|---|
| **Levin Lin and Chu** | Less than unity | Strongly Balanced | Assumed |
| **Shin test (2003)** | Less than unity | Balanced | Assumed |
| **Harris and Tzavalis (1999)** | Greater than unity | Strongly Balanced | Not Assumed |

In this study N/T ratio is clearly less than unity for middle income group countries and unity for high income group countries, panel is strictly balanced and because countries are independent of one another, cross sectional heterogeneity holds true. Hence widely accepted Levin Lin and Chu (2002) test has been performed on all the variables. The results of the same have been included in annexure.

## 5. Empirical Analysis and Results:

In order to combine cross-sectional with time series data and formulate the characteristics of the economies, we used pooling methods for our panel data. A general model for panel data is as follows:

$$y_{it} = x_{it} * \beta + z_{it} * a + \varepsilon_{it}$$

Where $\mathbf{y_{it}}$ is the dependent variable, the $\mathbf{x_{it}}$ matrix with the independent variables and $\mathbf{z_{it}}$ matrix which contains a constant term and/or a set of individual or group specific variables (depending on the sample), which may be observed or unobserved.

In case where, in the original model the matrix z includes only a constant term the model can be estimated as a classical linear model (Total Effects Model) and the method to perform the analysis is the pooled least square. On the other hand, if the observations have individual or group effects, then those effects must be taken into account and have to be included into the z matrix.
There are two ways to estimate the model that includes those effects. The first one is the random effects model which estimates the coefficient matrix under the assumption that the individual and/or group effects are uncorrelated with the other independent variables and can be formulated. The second one is the fixed effects model, which relaxes these two restrictions. The hypothesis that will be tested is that total debt (short- and long-term debt) can be seen as a function of the size of the country, annual expenditures incurred by it, the interest rate, the growth of the GDP inflation rate, current account balance, Foreign direct investments into a country and population density /population above 65 years of age for both middle income and high income group.

## Estimating Equation: Middle Income Countries, Total Debt

Modelling the Indian market according to the variables described in the previous section, we Estimate the following model:

$$TD_{it} = \beta_0 + \beta_1 * CA_{it} + \beta_2 * EXP_{it} + \beta_3 * INT_{it} + \beta_4 * GDPG_{it} + \beta_5 * INF_{it} + \beta_6 * FDI_{it} + \beta_7 * PD_{it} + \varepsilon_{it}$$

**(Equation 2)**

Where:

- $TD_{it}$ is the public debt to GDP ratio of the country i at time t,
- $CA_{it}$ the current account balance of the country i at time t,
- $EXP_{it}$ is the expenditures of the central government of country i at time t,
- $INT_{it}$ is the prevailing long term interest rate in country I at time t
- $GDPG_{it}$ is the rate of growth of real GDP of country i at time t,
- $INF_{it}$ is anuual inflation consumer prices of country i at time t,
- $FDI_{it}$ is foreign direct investment of country i at time t,
- $PD_{it}$ is the number of people per sq km for country i at time t.

Under the assumption that there are no group or individual effects among the countries included in our sample, we estimate the 'Total Effects' model. All the variables except current account balance and population density proved to be significant at confidence level of 5 per cent. The power of the model is given by the F-statistic of 17. According to adjusted $R^2$ the independent variables explain the 27 per cent of the size in the debt ratio, which is quite less.
In second case where all the effects are uncorrelated with the regressors and can be formulated as constant terms for each individual or group of companies in the known matrix z, the diagnostics from the fixed effects model suggest that the variable of growth is not statistically significant and does not affect the debt ratio. The adjusted $R^2$ is 11%.After applying the fixed effects model there is a contradictory result concerning the variable of current account. The fixed and the random effects model accept this variable but the total effects model does not. On the other hand, expenditure and FDI are significant according to fixed and random effects are insignificant according to the total model. Further, the $R^2$ is quite less to be assumed as a powerful model. These controversial results indicate that further analysis has to be done.
In order to enhance the $R^2$ of the model, we add Auto Regressive terms Ar(1) and Ar(2) to the above model (equation 2).The results indicate Inflation, interest rate, population density, fdi and expenditure to be insignificant. $R^2$for the new equation is 75% which is a significant improvement

over the previous model but still it is not good enough for us to be able to forecast the total debt figures. Current account balance and GDP growth are the only two variables which have a significant effect on the total debt of a middle income group country according to the Auto regressive model.It is also important to note that FDI, inflation and education expenditure become insignificant in case of an auto regressive model which means their effect gets captured in the past values of the debt.

The total debt in case of middle income group countries is negatively correlated with the GDP growth rate which is in line with the expectations. This means as GDP growth rate increases, debt levels decrease whereas current account balance is positively correlated with the total public debt in case of middle income countries.
Similar analysis was carried out for high income group countries. The results for the four models used for both high and middle income group have been summarized in the following table. In case of high income group countries the total debt is just dependent upon GDP growth rate. All other variables are found to be insignificant in auto regressive model. This is one clear distinction between middle income and high income countries. In high income group, $R^2$ from the Autoregressive model was good enough for it to be categorized as a powerful model and hence has been used for forecasting purposes.

**Table 3 Regression Results Summary**

| Variable | Middle Income Group Countries | | | | High Income Group Countries | | | |
|---|---|---|---|---|---|---|---|---|
| | Total Effects | Cross Section Fixed | Cross Section Random | Auto Regressive Model | Total Effects | Cross Section Fixed | Cross Section Random | Auto Regressive Model |
| **Current Account Balance** | I | S | S | S | I | S | S | I |
| **Expenditure** | S | I | I | I | I | S | S | I |
| **FDI** | S | I | I | I | I | I | I | I |
| **Inflation** | S | S | S | I | I | I | I | I |
| **Interest rate** | S | S | S | I | NA | NA | NA | I |
| **Population Density** | I | I | I | I | I | I | I | I |
| **Population Above 65** | I | I | I | I | I | I | I | I |
| **Number of Lags** | NA | NA | NA | 2 | NA | NA | NA | 2 |
| **GDP Growth** | S | S | S | S | S | S | S | S |

***S- Significant(95% confidence Level)** ***I- Insignificant** ***NA-Not Applicable**

The above table 3 illustrates that for high income group countries, under Total Effects model: all variables except GDP growth rate are found to be insignificant. Both Cross section Fixed and Cross section random effects model indicate similar results with Current account balance, Expenditure and GDP growth rate being found to be significant for determining the Debt to GDP ratio. The Eviews results for both groups and all models have been included in Annexure.

## Forecasting Public debt

### Estimation Equation: Central Debt, High Income Group

$$TD_{it} = \beta_0 + \beta_4 * GDPG_{it} + C1 * AR(1) + C2 * AR(2)$$

Substituted Coefficients:

$$TOTALDEBT = 49.8471817856 - 0.208769762917 * GDPGROWTH + [1.31389702052 * AR(1) - 0.374500193005 * AR(2)]$$

(Equation 3)

The forecasts have been made using IMF forecasts for GDP for all the selected countries till 2015 assuming two scenarios. Under baseline scenario the IMF forecasts have been taken directly without making any adjustment to them. Under shock scenario the GDP forecast figures have adjusted downwards by a factor equivalent to 0.5 times the historical standard deviation.

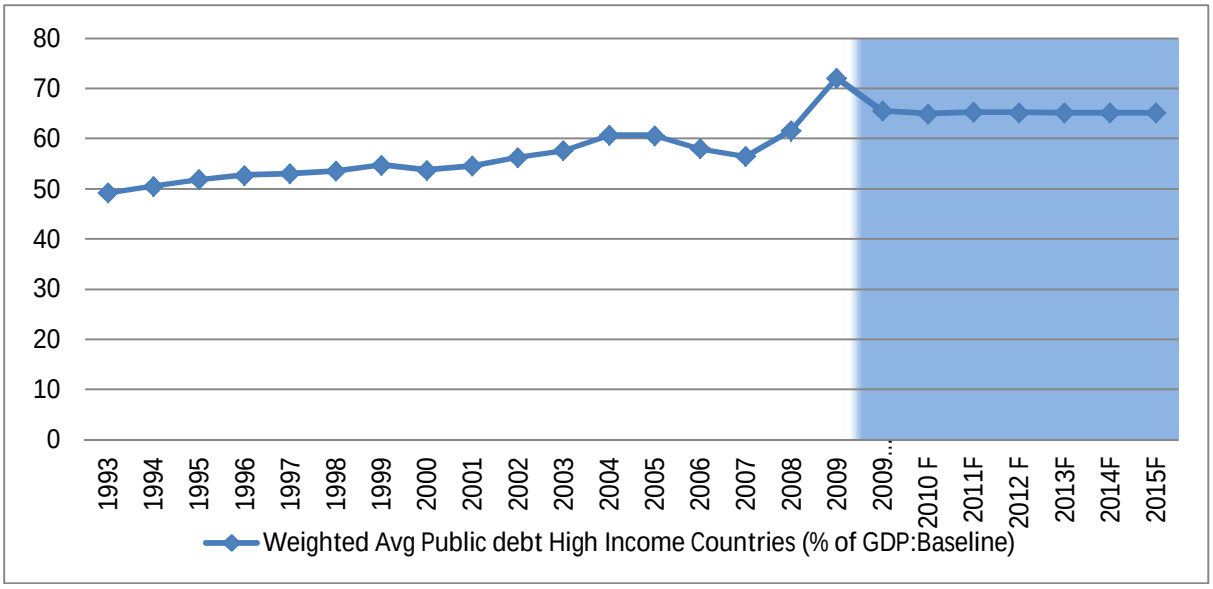


Figure 1Weighted Average Public Debt to GDP Baseline Forecast

Figure 1 illustrates the weighted average public debt forecast for high income group countries. The weights have assigned according to the contribution to world's GDP. Based on the forecasts of the Baseline scenario, the weighted average Public debt of 19 countries under consideration, will hover around 65%..Under the Shock Scenario this figure will jump upto 70%.

Figure 2 indicates the forecasted figures of Debt to GDP ratios for the next five years for all High income group countries under baseline scenario. Countries including Switzerland, Slovak Republic Korea, Germany, France and Japan, are found to be deteriorating in terms of the debt to GDP ratios in next five years. The figures for Ireland indicate significant improvement but the debt situation of crisis ridden Greece and Spain is unlikely to change much.
Canada, Denmark, Sweden, United States, Poland, Hungary, Portugal and Italy indicate slight improvement over the next five years. Australia continues to be among the lowest in terms of debt to GDP ratios.

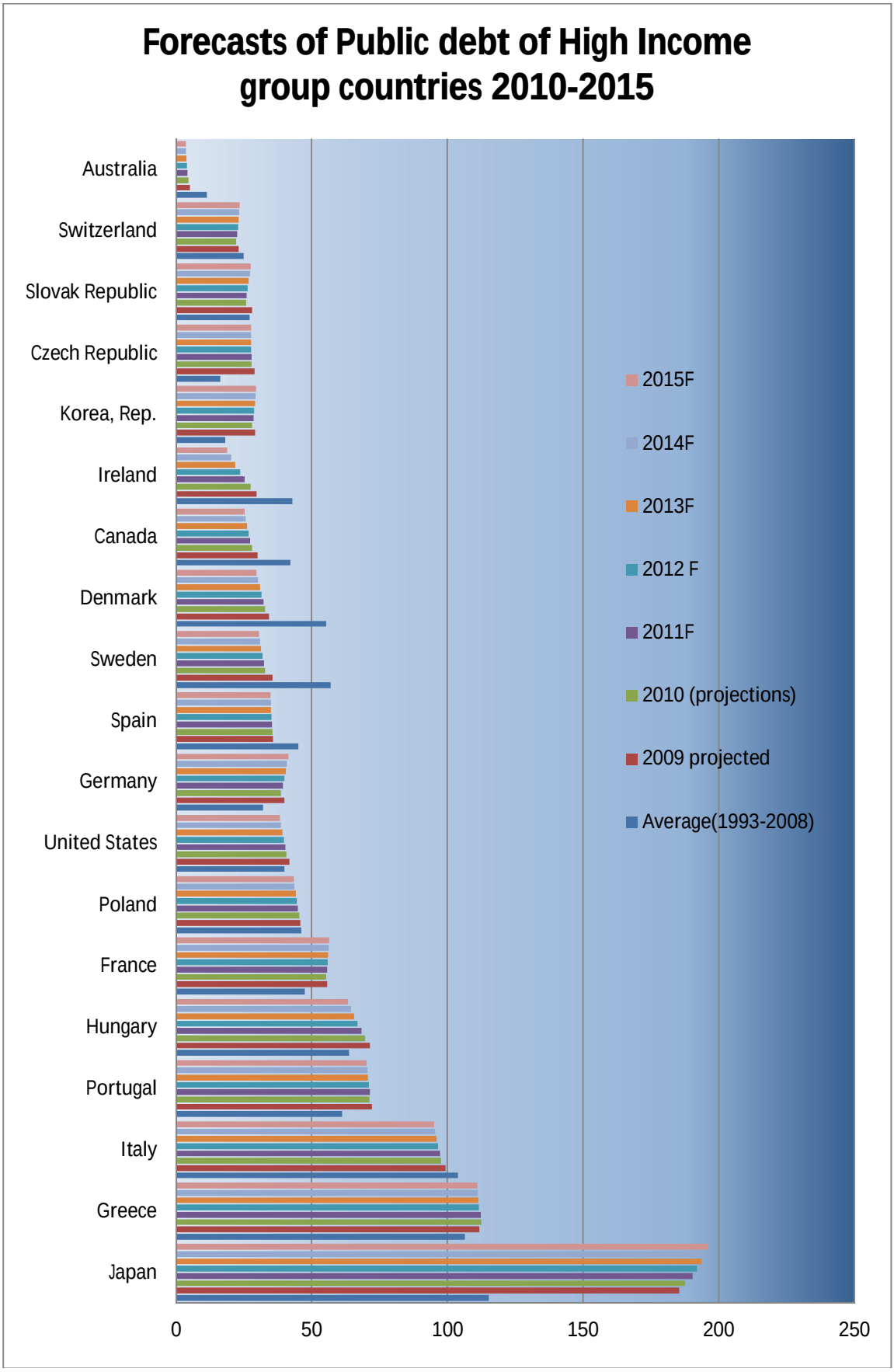


Figure 2 Forecasts of Public debt % of GDP Baseline scenario

## Shock scenario:

Since central government debt is dependent only on GDP growth rate for high income group countries as indicated in our multiple regression models, the only shock scenario possible is Real GDP shock scenario. In this case the IMF forecasts have been tweaked a little bit to accommodate for a shock. The forecast figures have been adjusted by 0.5 times the historical standard deviation of GDP growth rate of the respective country. Figure 3 indicates the comparison of Average Real GDP growth rate under two scenarios.

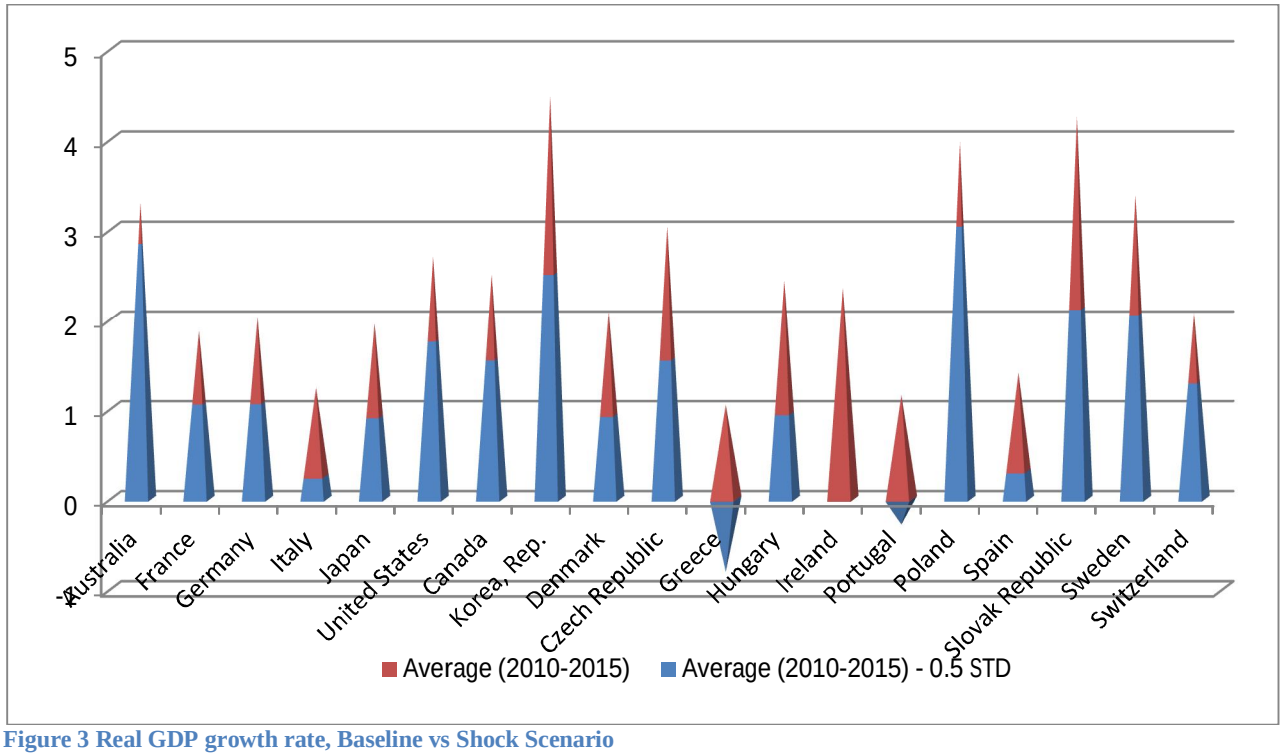


**Figure 3 Real GDP growth rate, Baseline vs Shock Scenario**

Figure 4 indicates the forecasted figures of Debt to GDP ratios for the next five years for all High income group countries under shock scenario. Shock scenario also indicates similar trends as Baseline scenario except for the magnitude of the change. If a nation has improved under Baseline scenario in terms of debt situation the magnitude of that improvement has gone down under shock scenario. On the other hand if a country's debt situation has worsened under baseline scenario, the magnitude of the fall has gone up under shock scenario. Debt situation of Spain under shock scenario deteriorates as compared to Baseline scenario where it remains stable.

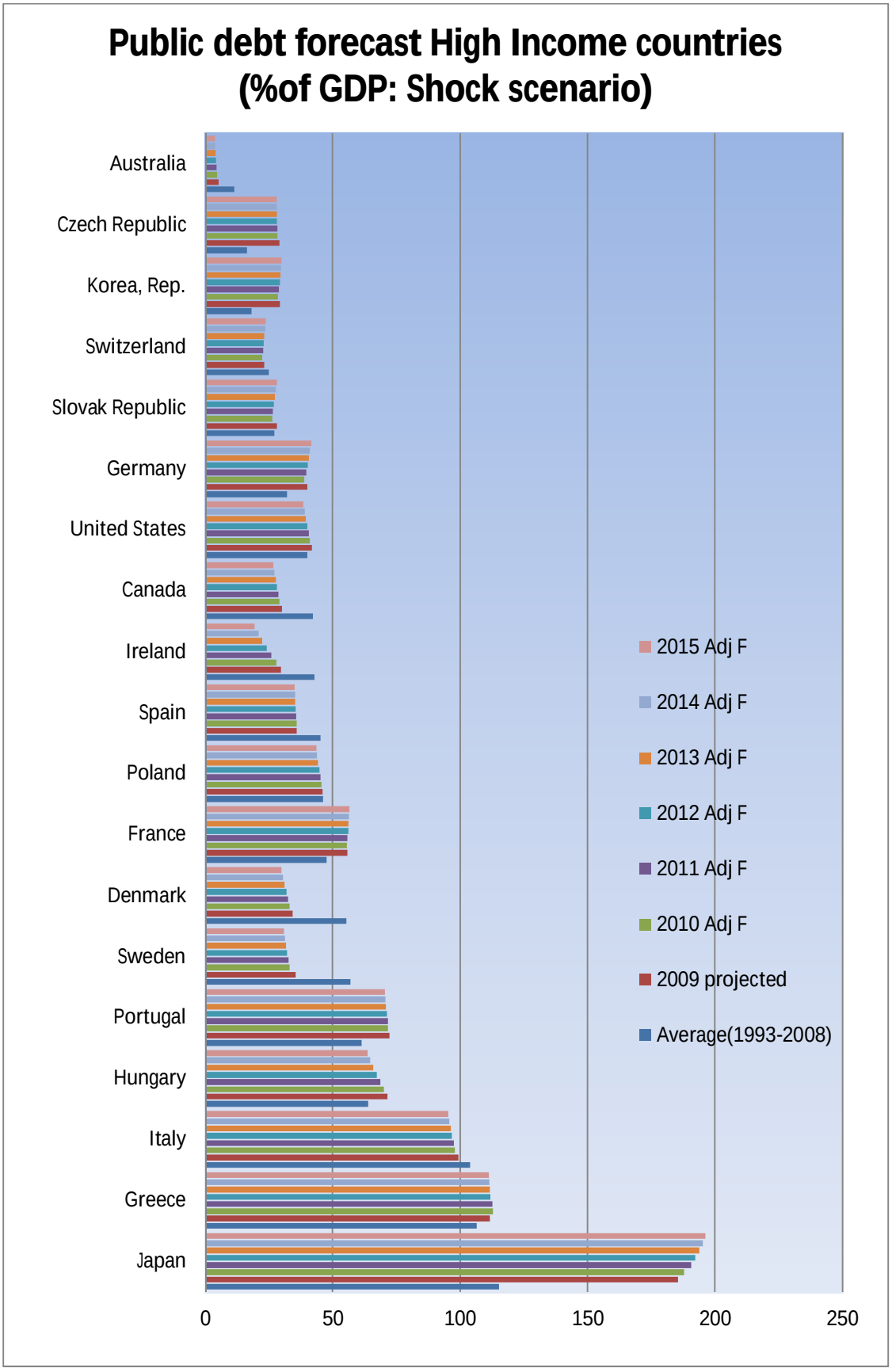


Figure 4 Public Debt forecast, Shock Scenario

### Comparison across middle and high income group countries

To study the impact of various other variables on debt of high and middle income group countries a separate model was prepared. The purpose of this regression is not to forecast the values of debt but to understand which variables affect the debt values the most.

While preparing the model following considerations were taken in to account:

1. Out of inflation and interest rate only one was considered
2. Expenditure was dropped since education expenditure has been considered; given high degree of correlation between the two

## Results for high income group countries

**Table 4 Result for high income: comparison with Middle Income**

Dependent Variable: TOTALDEBT(1)
Method: Panel Least Squares
Sample (adjusted): 1993 2007
Periods included: 15
Cross-sections included: 19
Total panel (balanced) observations: 285

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| C | 77.40131 | 7.947392 | 9.739208 | 0.0000 |
| GDPGROWTH(1) | -2.809004 | 0.827849 | -3.393135 | 0.0008 |
| EDUEXP(1) | -3.461409 | 1.498779 | -2.309486 | 0.0216 |
| FDI(1) | -0.283915 | 0.346558 | -0.819243 | 0.4133 |
| INFLATION(1) | -0.208835 | 0.413430 | -0.505127 | 0.6139 |
| CURRENTACNT(1 | -0.240010 | 0.389079 | -0.616868 | 0.5378 |

| | | | |
|---|---|---|---|
| R-squared | 0.068999 | Mean dependent var | 50.13034 |
| Adjusted R-squared | 0.052315 | S.D. dependent var | 32.25641 |
| S.E. of regression | 31.40133 | Akaike info criterion | 9.752405 |
| Sum squared resid | 275106.1 | Schwarz criterion | 9.829300 |
| Log likelihood | -1383.718 | Hannan-Quinn criter. | 9.783230 |
| F-statistic | 4.135513 | Durbin-Watson stat | 0.050085 |
| Prob(F-statistic) | 0.001221 | | |

## Result for Middle income countries

**Table 5 Results for Middle Income: Comparison with High Income**

Dependent Variable: TOTALDEBT(1)
Method: Panel Least Squares
Sample (adjusted): 1980 2007
Periods included: 28
Cross-sections included: 12
Total panel (balanced) observations: 336

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| C | 7.947466 | 0.570367 | 13.93395 | 0.0000 |

| | | | | |
|---|---|---|---|---|
| GDPGROWTH(1) | -0.277581 | 0.039897 | -6.957498 | 0.0000 |
| EDUEXP(1) | -0.085679 | 0.158253 | -0.541403 | 0.5886 |
| INFLATION(1) | -0.001625 | 0.000379 | -4.285400 | 0.0000 |
| FDI(1) | 0.198916 | 0.094822 | 2.097784 | 0.0367 |
| CURRENTACNT(1) | 0.060068 | 0.039110 | 1.535875 | 0.1255 |

| | | | |
|---|---|---|---|
| R-squared | 0.166841 | Mean dependent var | 6.602665 |
| Adjusted R-squared | 0.154217 | S.D. dependent var | 3.412740 |
| S.E. of regression | 3.138576 | Akaike info criterion | 5.143111 |
| Sum squared resid | 3250.718 | Schwarz criterion | 5.211274 |
| Log likelihood | -858.0427 | Hannan-Quinn criter. | 5.170283 |
| F-statistic | 13.21656 | Durbin-Watson stat | 0.455616 |
| Prob(F-statistic) | 0.000000 | | |

The Findings of the comparison are:

- Education expenditure has more significance in case of high income group countries as compare to middle income group countries. This is an important finding as it highlights the difference between the expenditure patterns of middle income and high income group countries. Because high income group countries spend alot on the education, this variable becomes significant determinant of their debt which is not the case with middle income group countries.
- FDI has more impact on the debt of middle income group countries as compare to high income countries. This is also an important finding given the as Foreign direct investment in terms of % of GDP is always more for developing countries( middle income group countries)
- Inflation / Interest rate is found to be significant in case of middle income and not high income group countries. This indicates the variability in inflation/interest rates which is quite less in case of high income group countries whereas it is generally very high for middle income. Because of high variability, any change in the interest rates/ inflation has significant impact on the borrowing cost of the government which is not the case with high income group countries.
- It is also important to note that FDI, inflation and education expenditure become insignificant in case of an auto regressive model which means their effect gets captured in the past values of the debt.

## 6. Conclusion

The most significant finding of this research has been, the GDP growth rate being the most important determinant of the public debt. Government expenditure is also a significant determinant depending upon the country being a high income group country or not. In middle income group in addition to the GDP growth rate, current account balance also significantly impacts the debt situation. The paper also successfully concludes that Education expenditure has stronger influence on debt of a high income group country as compared to a middle income group country whereas FDI influences the debt of middle income group country much more than the debt of a high income group country. High income group countries including Switzerland, Slovak Republic Korea, Germany, France and Japan, are found to be deteriorating in terms of the debt to GDP ratios in next five years. The figures for Ireland indicate significant improvement but the debt situation of crisis ridden Greece and Spain is unlikely to change much.

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## Annexure I:

Stationarity tests results:

| Variable | High Income Group | | | | Middle Income Group | | | |
|---|---|---|---|---|---|---|---|---|
| | T Value | Prob Value | T Value | Prob Value | T Value | Prob | T Value | Prob Value |
| | Zero Level | | First Difference | | Zero Level | | First Difference | |
| **Current account balance** | 2.706 | .0034 | NR | NR | -1.06 | .1434 | -7.7 | 0.000 |
| **Expenditure** | 1.117 | .1331 | 4.53 | 0.000 | .64 | .739 | 4.7926 | 0.000 |
| **External debt** | 1.254 | .1302 | 6.103 | 0.000 | NR | NR | NR | NR |
| **FDI** | .9655 | .1671 | 6.2651 | 0.000 | 3.13 | 0.0009 | NR | NR |
| **GDP growth** | 6.63 | 0.000 | NR | NR | .25 | .4 | 5.81 | 0.000 |
| **Inflation** | 3.904 | 0.000 | NR | NR | 4.95 | 0.000 | NR | NR |
| **Interest Rate** | 4.537 | 0.000 | NR | NR | NA | NA | NA | NA |
| **Population Density** | 5.94 | 0.000 | NR | NR | .186 | .425 | 2.12 | .016 |
| **Total Debt** | .599 | .2744 | 7.35 | 0.000 | 2.79 | .0076 | NR | NR |
| **Education Expenditure** | 1.45 | .073 | 6.971 | 0.000 | 15.69 | 0.000 | NR | NR |
| **Military Expenditure** | 2.697 | .0035 | NR | NR | NA | NA | NA | NA |
| ***NR-Not Required Analysed** | | | | | | | | ***NA-Not** |

## Annexure II:

Pooled Least Square Mode Middle Income Group Total Debt estimation

| | | | | |
|---|---|---|---|---|
| Dependent Variable: TOTALDEBT(1) | | | | |
| Method: Panel Least Squares | | | | |
| Sample (adjusted): 1980 2008 | | | | |
| Periods included: 29 | | | | |
| Cross-sections included: 12 | | | | |
| Total panel (balanced) observations: 348 | | | | |
| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
| C | 9.278598 | 0.934262 | 9.931471 | 0.0000 |
| CURRENTACNT(1) | 0.063827 | 0.036836 | 1.732756 | 0.0840 |
| GDPGROWTH(1) | -0.209153 | 0.036288 | -5.763642 | 0.0000 |
| INFLATION(1) | -0.001433 | 0.000361 | -3.971326 | 0.0001 |
| INTERESTRATE(1) | 0.274305 | 0.080077 | 3.425524 | 0.0007 |
| EXPENDITURE(1) | -0.319472 | 0.053697 | -5.949521 | 0.0000 |
| FDI(1) | 0.333386 | 0.094187 | 3.539617 | 0.0005 |
| POPUDENSITY(1) | -0.003949 | 0.002020 | -1.955299 | 0.0514 |
| R-squared | 0.267907 | Mean dependent var | | 6.528700 |
| Adjusted R-squared | 0.252834 | S.D. dependent var | | 3.419679 |
| S.E. of regression | 2.955928 | Akaike info criterion | | 5.028223 |
| Sum squared resid | 2970.754 | Schwarz criterion | | 5.116779 |

| | | | |
|---|---|---|---|
| Log likelihood | -866.9107 | Hannan-Quinn criter. | 5.063479 |
| F-statistic | 17.77451 | Durbin-Watson stat | 0.468682 |
| Prob(F-statistic) | 0.000000 | | |

**Cross Section (fixed) Middle Income group Total Debt estimation**

| | | | | |
|---|---|---|---|---|
| Dependent Variable: TOTALDEBT(1) | | | | |
| Method: Panel Least Squares | | | | |
| Sample (adjusted): 1980 2008 | | | | |
| Periods included: 29 | | | | |
| Cross-sections included: 12 | | | | |
| Total panel (balanced) observations: 348 | | | | |
| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
| C | 4.466171 | 1.209153 | 3.693636 | 0.0003 |
| CURRENTACNT(1) | 0.105425 | 0.034323 | 3.071545 | 0.0023 |
| GDPGROWTH(1) | -0.125001 | 0.031635 | -3.951307 | 0.0001 |
| INFLATION(1) | -0.001105 | 0.000294 | -3.760666 | 0.0002 |
| INTERESTRATE(1) | 0.264394 | 0.074281 | 3.559392 | 0.0004 |
| EXPENDITURE(1) | -0.059942 | 0.061653 | -0.972243 | 0.3316 |
| FDI(1) | 0.088135 | 0.088482 | 0.996078 | 0.3199 |
| POPUDENSITY(1) | 0.016759 | 0.007100 | 2.360558 | 0.0188 |
| Effects Specification | | | | |

| Cross-section fixed (dummy variables) | | | |
|---|---|---|---|
| R-squared | 0.562221 | Mean dependent var | 6.528700 |
| Adjusted R-squared | 0.538270 | S.D. dependent var | 3.419679 |
| S.E. of regression | 2.323698 | Akaike info criterion | 4.577247 |
| Sum squared resid | 1776.459 | Schwarz criterion | 4.787569 |
| Log likelihood | -777.4410 | Hannan-Quinn criter. | 4.660980 |
| F-statistic | 23.47337 | Durbin-Watson stat | 0.666172 |
| Prob(F-statistic) | 0.000000 | | |

Cross Section (Random) Middle Income Group Total Debt Estimation

| Dependent Variable: TOTALDEBT(1) | | | | |
|---|---|---|---|---|
| Method: Panel EGLS (Cross-section random effects) | | | | |
| Sample (adjusted): 1980 2008 | | | | |
| Periods included: 29 | | | | |
| Cross-sections included: 12 | | | | |
| Total panel (balanced) observations: 348 | | | | |
| Swamy and Arora estimator of component variances | | | | |
| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
| C | 5.648938 | 1.298194 | 4.351381 | 0.0000 |
| CURRENTACNT(1) | 0.105140 | 0.034036 | 3.089055 | 0.0022 |
| GDPGROWTH(1) | -0.128826 | 0.031484 | -4.091868 | 0.0001 |
| INFLATION(1) | -0.001098 | 0.000293 | -3.745419 | 0.0002 |

| | | | | |
|---|---|---|---|---|
| INTERESTRATE(1) | 0.240840 | 0.073042 | 3.297289 | 0.0011 |
| EXPENDITURE(1) | -0.068920 | 0.060262 | -1.143670 | 0.2536 |
| FDI(1) | 0.125596 | 0.086966 | 1.444193 | 0.1496 |
| POPUDENSITY(1) | 0.006467 | 0.005240 | 1.234249 | 0.2180 |

| Effects Specification | | |
|---|---|---|
| | S.D. | Rho |
| Cross-section random | 2.328301 | 0.5010 |
| Idiosyncratic random | 2.323698 | 0.4990 |

| Weighted Statistics | | | |
|---|---|---|---|
| R-squared | 0.127752 | Mean dependent var | 1.189694 |
| Adjusted R-squared | 0.109793 | S.D. dependent var | 2.471619 |
| S.E. of regression | 2.331991 | Sum squared resid | 1848.982 |
| F-statistic | 7.113884 | Durbin-Watson stat | 0.640025 |
| Prob(F-statistic) | 0.000000 | | |

| Unweighted Statistics | | | |
|---|---|---|---|
| R-squared | 0.111330 | Mean dependent var | 6.528700 |
| Sum squared resid | 3606.125 | Durbin-Watson stat | 0.328163 |

**AR Model Iteration 1:Middle Income Total Debt Estimation**

Dependent Variable: TOTALDEBT(1)

Method: Panel Least Squares

Sample (adjusted): 1982 2008

Periods included: 27

Cross-sections included: 12

Total panel (balanced) observations: 324

Convergence achieved after 9 iterations

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| C | 7.225256 | 1.606685 | 4.496996 | 0.0000 |
| CURRENTACNT(1) | 0.088629 | 0.030753 | 2.881992 | 0.0042 |
| GDPGROWTH(1) | -0.072754 | 0.022387 | -3.249821 | 0.0013 |
| INFLATION(1) | -0.000315 | 0.000209 | -1.510037 | 0.1320 |
| INTERESTRATE(1) | 0.083482 | 0.090956 | 0.917826 | 0.3594 |
| EXPENDITURE(1) | -0.083521 | 0.092628 | -0.901675 | 0.3679 |
| FDI(1) | 0.062613 | 0.085302 | 0.734020 | 0.4635 |
| POPUDENSITY(1) | -0.004142 | 0.006428 | -0.644349 | 0.5198 |
| AR(1) | 0.703285 | 0.056613 | 12.42269 | 0.0000 |
| AR(2) | 0.156155 | 0.055680 | 2.804505 | 0.0054 |

| | | | |
|---|---|---|---|
| R-squared | 0.755129 | Mean dependent var | 6.553566 |
| Adjusted R-squared | 0.748110 | S.D. dependent var | 3.391721 |
| S.E. of regression | 1.702257 | Akaike info criterion | 3.932165 |

| | | | |
|---|---|---|---|
| Sum squared resid | 909.8715 | Schwarz criterion | 4.048855 |
| Log likelihood | -627.0108 | Hannan-Quinn criter. | 3.978741 |
| F-statistic | 107.5898 | Durbin-Watson stat | 2.017755 |
| Prob(F-statistic) | 0.000000 | | |
| Inverted AR Roots | .88 | -.18 | |

**Iteration2: Middle Income Group Total Debt estimation**

Dependent Variable: TOTALDEBT(1)

Method: Panel Least Squares

Sample (adjusted): 1982 2008

Periods included: 27

Cross-sections included: 12

Total panel (balanced) observations: 324

Convergence achieved after 8 iterations

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| C | 6.155409 | 0.779700 | 7.894585 | 0.0000 |
| CURRENTACNT(1) | 0.094986 | 0.029652 | 3.203411 | 0.0015 |
| GDPGROWTH(1) | -0.065525 | 0.021929 | -2.988087 | 0.0030 |
| AR(1) | 0.723348 | 0.055710 | 12.98408 | 0.0000 |
| AR(2) | 0.149732 | 0.055211 | 2.711972 | 0.0071 |
| R-squared | 0.751507 | Mean dependent var | | 6.553566 |

| | | | |
|---|---|---|---|
| Adjusted R-squared | 0.748391 | S.D. dependent var | 3.391721 |
| S.E. of regression | 1.701308 | Akaike info criterion | 3.915983 |
| Sum squared resid | 923.3288 | Schwarz criterion | 3.974328 |
| Log likelihood | -629.3893 | Hannan-Quinn criter. | 3.939271 |
| F-statistic | 241.1850 | Durbin-Watson stat | 2.010599 |
| Prob(F-statistic) | 0.000000 | | |
| Inverted AR Roots | .89 | -.17 | |

## Annexure III:

**Total effects model High Income Group, Central Debt Estimation**

Dependent Variable: TOTALDEBT

Method: Panel Least Squares

Sample (adjusted): 1995 2014

Periods included: 20

Cross-sections included: 19

Total panel (balanced) observations: 380

Convergence achieved after 7 iterations

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| GDPGROWTH | -0.193155 | 0.040204 | -4.804423 | 0.0000 |
| AR(1) | 1.599115 | 0.037542 | 42.59483 | 0.0000 |
| AR(2) | -0.599819 | 0.037724 | -15.89999 | 0.0000 |

| | | | |
|---|---|---|---|
| R-squared | 0.994791 | Mean dependent var | 50.44196 |
| Adjusted R-squared | 0.994763 | S.D. dependent var | 35.48716 |
| S.E. of regression | 2.568046 | Akaike info criterion | 4.732031 |
| Sum squared resid | 2486.263 | Schwarz criterion | 4.763138 |
| Log likelihood | -896.0859 | Hannan-Quinn criter. | 4.744375 |
| Durbin-Watson stat | 2.228169 | | |

| | | |
|---|---|---|
| Inverted AR Roots | 1.00 | .60 |

**AR Fixed Effects model, High Income Group Countries, Central Debt Estimation**

Dependent Variable:TOTALDEBT(1)

Method: Panel Least Squares

Sample (adjusted): 1995 2007

Periods included: 13

Cross-sections included: 19

Total panel (balanced) observations: 247

Convergence achieved after 8 iterations

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| C | 49.81125 | 2.441016 | 20.40595 | 0.0000 |
| GDPGROWTH(1) | -0.193538 | 0.078000 | -2.481255 | 0.0138 |
| AR(1) | 1.231696 | 0.064613 | 19.06261 | 0.0000 |
| AR(2) | -0.305359 | 0.062942 | -4.851407 | 0.0000 |

Effects Specification

Cross-section fixed (dummy variables)

| | | | |
|---|---|---|---|
| R-squared | 0.993250 | Mean dependent var | 49.72918 |
| Adjusted R-squared | 0.992620 | S.D. dependent var | 32.57903 |
| S.E. of regression | 2.798676 | Akaike info criterion | 4.981020 |
| Sum squared resid | 1762.332 | Schwarz criterion | 5.293597 |
| Log likelihood | -593.1559 | Hannan-Quinn criter. | 5.106866 |
| F-statistic | 1576.687 | Durbin-Watson stat | 1.943807 |
| Prob(F-statistic) | 0.000000 | | |